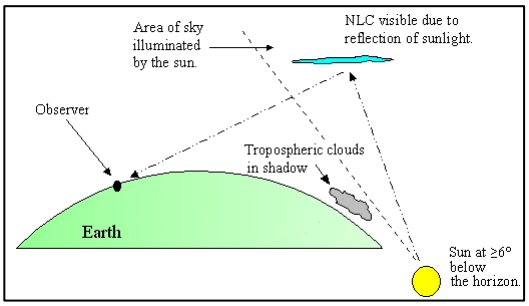
Noctilucent Clouds, Comets, and Meteor Showers

By Lou Mayo

During summer months, observers at high northern latitudes may be treated to a rare atmospheric phenomenon. Just after the sun has dropped below the horizon and the sky begins to darken, look west and you may be able to see Noctilucent or "Night Shining" Clouds. Also called PMCs (Polar Mesospheric Clouds), these apparitions are a bit of a puzzle for scientists because it is not entirely clear how they form.

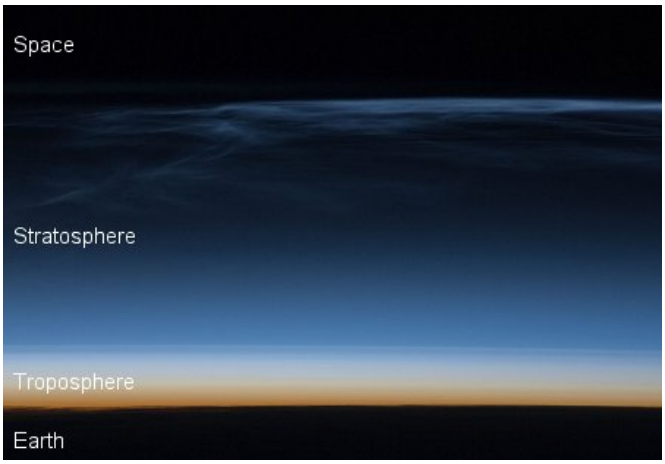


Noctilucent clouds are composed of water ice crystals in the rarified upper regions of Earth's atmosphere (called the Mesosphere), between 50-53 miles up, just on the edge of space. These clouds are so high that they can still reflect sunlight long after the sun has set to us at sea level. At these altitudes, the atmosphere is so thin that it is rare for water molecules to come together. So, these clouds need some help. In their lower altitude brothers, like Cirrus clouds, water condenses out of the atmosphere onto "seed nuclei", typically dust particles from Earth's surface blown upward by convective cells of air. This is very similar to the process that causes water droplets to form on the outside of a glass of cold ice tea on a hot summer's day. Here, the glass acts as a nucleation site to pull water out of the atmosphere. However, there isn't much in the way of dust at 50 miles in altitude so something else must be providing the nucleation material to coax the water out of solution. Though there is some disagreement as to the amount, 10's to 100's of tons of cosmic material mostly in the form of dust grains falls on Earth's atmosphere every day. So, there is speculation that dust of cosmic origin from comets and meteoroids may provide this material.

This may be the case with comet ISON. As comet ISON nears the sun, and its surface heats up, more and more of its surface ices will be sublimed away into space, releasing any trapped dust particles. Computer models show that Earth will pass through this debris stream of very fine dust particles left in the wake of ISON sometime around the 12th of January, 2014. Since the dust grains are expected to be quite small (only a few microns in size), we likely will not see a meteor shower. But these dust grains are just the right size to act as nucleation sites for mesospheric ice crystals to form. So, speculation is mounting that there could be quite a display of noctilucent clouds during this time.

OTHER FACTRS IN PMC CLOUD FORMATION

There is now mounting evidence that PMCs are forming at lower and lower latitudes. One possible reason for this is the increase in CO2 in the atmosphere. While CO2 acts to warm lower parts of the atmosphere, it actually lowers the temperature in the upper parts thus providing the super cold conditions (<200 (F)) needed for Noctilucent Cloud formation. In addition, summer storms may push water vapor high into the mesosphere which would explain why these clouds are more prevalent in summer months.



NASA's AIM (Aeronomy of Ice in the Mesosphere) mission (http://www.nasa.gov/mission_pages/aim/index.html) is helping us understand these clouds, and is producing the first comprehensive, multi-year, global-scale view of PMC formation and evolution.